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ABSTRACT

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CENTER FOR THE STUDY OF READING

Technical Report No. 407

THE ACQUISITION OF ENGLISH DERIVATIONAL MORPHOLOGY

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Abstract

Three paper-and-pencil measures were administered to students in fourth, sixth, and eighth grades to assess different aspects of their knowledge of English derivational suffixes. Children appear to develop a rudimentary knowledge of derivational morphology--the ability to recognize a familiar stem in a derivative--before fourth grade. Knowledge of the syntactic properties of derivational suffixes appears to increase through eighth grade. Knowledge of the distributional properties of suffixes also increases, with sixth-grade students showing an increase in overgeneralization errors parallel to that found for inflectional suffixes in much younger children.

THE ACQUISITION OF ENGLISH DERIVATIONAL MORPHOLOGY

English derivational morphology, that is, the basic units of word formation and the principles governing their combination, has drawn increasing attention from researchers in linguistics, psychology, and reading over the past ten years. The findings indicate that knowledge of derivational morphology may be important in language processing in several ways: Knowledge of the internal structure of words may play a role in lexical access (Fowler, Napps, & Feldman, 1985; Stanners, Neiser, Herndon, & Hall, 1979; Taft & Forster, 1975). Because derivational suffixes mark words for part-of-speech, they may be useful in helping speakers establish the syntactic structure of sentences (Clark & Clark, 1977). Finally, knowledge of morphology appears to be helpful in assigning meaning to unfamiliar derivatives (Dowty, 1978; Jackendoff, 1975; Nagy & Anderson, 1984), thus facilitating vocabulary growth.

In spite of the increased attention given derivational morphology, we have only fragmentary and inconsistent information about its acquisition. Previous research on acquisition does not clearly identify when children acquire knowledge about the internal structure of words, just what knowledge they acquire, or how well they are able to utilize such knowledge. This paper reports research aimed at establishing a fuller picture of children's acquisition of English derivational morphology by distinguishing different aspects of knowledge about morphology, and by examining the effects of various task demands on children's ability to demonstrate their implicit knowledge.

Some research indicates that the acquisition of derivational morphology begins as early as the preschool years. Clark and Cohen (1984) found evidence of some knowledge of the agentive suffixes *-er* and *-ist* even for four- and five-year-olds, and Condry (1979) found that second graders had already begun to learn the relationship between stems and derived forms with common suffixes, such as *argue* and *argument*. But even if some derivational suffixes such as *-er* are acquired fairly early, several studies suggest that, in general, students in the middle grades do not have much knowledge of morphology, nor make much use of what knowledge they may have. Freyd and Baron (1982) compared above-average fifth graders with average eighth graders in their use of suffixes when learning morphologically-related nonce words. Children were taught a list of nonce words, half of which were related by real English suffixes (e.g., *prok* meant "high" and *prokness* meant "top"). For the other half of the words, the suffixed and nonsuffixed forms had totally unrelated meanings. The students' knowledge of derivational morphology should be reflected in a better score for the former group of words than for the latter. Results indicated that bright fifth graders evidenced some knowledge of morphological relations while average eighth graders did not demonstrate this knowledge. Furthermore, neither group incorporated the part-of-speech information inherent in the suffixes into their definitions.

Wysocki and Jenkins (1987) taught fourth, sixth, and eighth grade students the meanings of infrequent words such as *sapient*, and then tested their knowledge of suffixed derivatives, e.g., *sapience*. Although eighth graders were usually able to recognize the relationship between the suffixed derivative and the word they had been taught, they were able to demonstrate knowledge of the syntactic contribution of the suffix for only a third of the suffixed derivatives, even though the words were presented in a context that made the part of speech of the word apparent.

Sternberg and Powell (1983), investigating students' use of common Latin prefixes and stems to infer the meanings of unfamiliar words such as *exsect*, found that college students, but not high school students, use the internal morphological structure to infer the meaning of a word.

At first glance, the available research presents a somewhat contradictory picture. But some order can be introduced by recognizing differences in the types of morphological knowledge that were being tested and the tasks used to test the knowledge. More specifically, it is necessary to take into account distinctions between classes of word formation processes, different types of knowledge about

derivational morphology, different degrees of knowledge of stems, and different types of tasks subjects have been asked to perform.

Categories of Suffixes

On linguistic grounds, it is useful to distinguish two classes of English derivational suffixes, Neutral and Non-Neutral suffixes. Neutral suffixes, such as *-ness*, *-er*, *-ize*, and *-ment*, have several properties which should make them relatively easy to learn. They attach to independent words; so, for example, when the suffix *-er* is removed from *owner*, the result is an independent word, *own*. Neutral suffixes do not cause changes of stress or vowel quality in the word to which they are added. Usually, although not always, the meaning of a word formed from Neutral suffixes is transparently related to that of the stem.

Non-neutral suffixes, such as *-ity*, *-ify*, *-ian*, *-ous*, *-ic*, or *-ive*, differ from Neutral suffixes in several respects. They often attach to bound morphemes (stems that are not words in their own right); hence, taking off the *-ify* in *gratify* or *quantify* fails to produce an independent word. Non-neutral suffixes tend to cause changes of stress and vowel quality in the stem to which they attach, as exemplified by the difference in the pronunciation of the *a* in *profane* and *profanity*. Finally, the meaning of words originally formed with Non-neutral suffixes is often not transparently related, as in the words formed from the bound morpheme *carn* 'meat' such as *carnival*, *carnivore*, *carnation*.

The two types of suffixes also vary in their applicability. Neutral suffixes have a wide range of applicability. The primary restriction on these suffixes is their subcategorization for the part-of-speech of the morpheme to which they can attach. So, for instance, the Neutral suffix *-er* can attach to virtually any verb in order to form an agentive. Non-neutral suffixes, on the other hand, do not have the same broad range of applicability. As Kiparsky (1982) points out, words formed from particular root morphemes take particular Non-neutral suffixes. For example, words containing the root *ceive* take *-tion*, as in *receive/reception*, *deceive/deception*, *perceive/perception*. The root *fer*, on the other hand, takes the suffix *-ence* as in *prefer/preference*, *refer/reference*. Moreover, within these paradigms there are often idiosyncratic exceptions; compare the triplets *arrive/arrival/*arrivation* and *derive/*derival/derivation*.

From the properties of Neutral and Non-neutral suffixes, one would predict that the former are acquired earlier, and more easily. The available data bear this out.

Dale and O'Rourke (1974) studied sixth, eighth, tenth, and twelfth graders' knowledge of the meaning of common English suffixes. The subjects were asked to match suffixes with a list of definitions. While there are some problems with the study, somewhat odd definitions and the artificiality of the task, the results show a definite trend of subjects at all ages having significantly more knowledge of Neutral suffixes than Non-neutral suffixes. Similarly, Sterling's (1982) study on 20 sixth graders' ability to use suffixes to form context-appropriate, novel forms shows a marked contrast in sixth grade children's knowledge of Neutral and Non-neutral suffixes. Condry (1979) and Clark and Cohen (1984), who found that young children use morphology to aid in learning new words, were looking at Neutral suffixes such as agentive *-er*.

Taking the type of suffix into account, then, already introduces more order into our picture of the acquisition of derivational morphology. Neutral suffixes are being acquired by some children even in the preschool years; in contrast, Non-neutral suffixes appear to be in the process of acquisition even as late as high school.

Another possible source of the contradictions among earlier findings is the difference between these studies in the degree of familiarity subjects had with the target words. Condry (1979) found evidence of third graders consistently seeing the relationship between familiar words such as *argue* and *argument*. In contrast, Freyd and Baron (1982) and Wysocki and Jenkins (1987), who found far less

evidence of children seeing lexical semantic relationships, tested subjects on newly-acquired stems. It might be that speakers tend to use morphological knowledge only with derivatives formed from familiar stems.

Some apparent discrepancies between previous studies might also be attributed to differences in the types of tasks that subjects were asked to perform. For example, the eighth graders in Freyd and Baron's (1982) study did not make use of suffixes in learning the meanings of nonce words. However, younger subjects in other studies did show some evidence of knowledge of suffixes in different types of tasks.

Both Freyd and Baron (1982) and Wysocki and Jenkins (1987) found their subjects unable to convey the syntactic contribution of derivational suffixes in a definitional task; that is, some subjects would incorrectly define *sapience* as "wise," rather than as "wisdom." However, Sterling (1982) found that for some Neutral suffixes, at least, sixth graders were sometimes able to produce novel forms that were contextually appropriate, that is, which reflected knowledge of the syntactic contribution of the suffix. This suggests that a definitional task imposes extraneous metalinguistic demands that prevent some subjects from evidencing knowledge of suffixes that they do, in fact, possess.

Finally, knowledge of morphology appears to be multifaceted. Studies designed to test one aspect of a subject's knowledge of morphology, as was the case with most previous studies, may miss part of a subject's knowledge. Full knowledge of derivational morphology involves at least three aspects, which we label lexical semantic, syntactic, and distributional knowledge. Lexical semantic knowledge is recognizing that words have complex internal structure and that two or more words may share a common morpheme. It is the knowledge that *create* is related to *creator* in a way that *me* is not related to *meter*. Syntactic knowledge is knowing that derivational suffixes mark words for syntactic category. For example, syntactic knowledge is the tacit knowledge that *regularize* is a verb by virtue of being suffixed with *-ize* and *regulation* is a noun by virtue of being suffixed with *-ion*. Distributional knowledge has to do with the constraints on the concatenation of stems and suffixes. For instance, *-ness* attaches to adjectives but not to verbs, so *quietness* is a fine word in English while **playness* is not.

It is not logically necessary, nor even likely, that children acquire all three aspects of word formation simultaneously. One could conceivably come to see that there was a *regulate* in *regulation* without knowing what part of speech the latter word was or without assigning any systematic part-of-speech characterization to *-ion* or *-ate*. Conversely, one might recognize on the basis of the suffix that *basement* was a noun without any perception of its relationship to the word *base*. We hypothesize that children acquire knowledge of distributional constraints after acquiring knowledge of lexical semantics and syntax since distributional constraints are in part determined by whether or not the stem morpheme is bound, as well as syntactic factors. Thus, one might expect to find an age at which children in the process of acquiring morphology had already acquired lexical semantic and/or syntactic knowledge of suffixes but had still not acquired knowledge of distributional constraints.

The present study attempts to provide the basis for a more coherent picture of the acquisition of suffixes by extending previous studies in several respects. Both Neutral and Non-neutral suffixes were examined, so that differences in their acquisition could be explored. Furthermore, three different types of experimental tasks were used, aimed at measuring the three different aspects of knowledge about suffixes. For clarity of presentation, the three tasks, though all administered to the same subjects in a single session, are reported here as three distinct experiments.

Experiment 1

Knowledge of Lexical Semantic Relationships

We consider the ability to recognize that two words share a common morpheme a basic level of knowledge of morphology, probably the first to be acquired. It is therefore surprising that the subjects in Freyd and Baron's (1982) and Wysocki and Jenkins' (1987) studies showed relatively little evidence of such knowledge. We hypothesized that in these studies, extraneous task demands may have lead to an underestimation of students' actual knowledge of morphological relationships. Specifically, it may be difficult for students to utilize their knowledge of suffixes when the stems involved are unfamiliar or only superficially known; also, producing definitions is more demanding than recognizing correct definitions.

A pilot experiment was therefore conducted in which students were asked to answer multiple choice questions about sentences containing low-frequency (and hence presumably unfamiliar) derivatives of high frequency stems. For example, we assumed that most fourth-grade students would already know the words *explosive* and *astronaut*, but that the derivatives *explosivity* and *astronautic* are infrequent enough that even eighth graders would not be likely to have encountered them before. A seven-item multiple choice test was constructed in which choosing the correct answer depended on knowing the meaning of a low-frequency derivative of a high-frequency stem such as *explosivity*. All seven derivatives involved Non-neutral suffixes.

This multiple choice test was administered to 21 students in fourth grade, 50 in sixth grade, 38 in eighth grade, and also to 12 college students who had been identified as less skilled readers. Fourth graders correctly answered an average of 39% of the items (corrected for guessing), and the mean score increased over the grades tested, with the college students answering 97% correctly.

This pilot study indicated that even fourth graders were able to demonstrate lexical semantic knowledge of derived forms. However, the test may still have underestimated students' knowledge of morphology. All the items in the pilot test involved Non-neutral suffixes, which are hypothesized to be more difficult to learn than Neutral suffixes. The pilot test also gave us no way to determine whehter failure to answer an item correctly reflected lack of morphological knowledge, or more general limitations on reading ability or test-taking skills. An experiment that attempted a more thorough measure of students' lexical semantic knowledge of suffixes was therefore conducted.

Method

Subjects

Subjects in this study were students in a medium-sized midwestern town, in schools different from those in which the pilot study had been conducted. There were 40 students in fourth grade, 30 in sixth grade, and 30 in eighth grade.

Procedures

Subjects took three paper and pencil tasks, of which the test constituting Experiment 1 was the second. Instructions for each task were read aloud by the experimenter as subjects followed along in their individual test booklets. Sufficient time was allowed for all subjects to complete each of the tasks.

Materials

Twenty-four multiple choice items were developed, for which choosing the correct answer depended crucially on the meaning of a target word. For each item, two versions were constructed. In one,the target word was a low-frequency derivative of a high-frequency word. The other version of the item was identical, except that the high-frequency stem itself was used. (Minor changes in wording were made to adjust for differences in part of speech between the stem and the derivative). An example of the two versions of an item is given in Table 1. Two versions of the test were constructed, so that each subject saw only one version of each item.

[Insert Table 1 about here.]

The low frequency target derivatives all had frequencies of less than 0.3 per million words of text (frequencies based on Carroll, Davies, & Richman, 1971). All the base words had frequencies ranging from 10 to 100 per million words of text, and hence were likely to be familiar, even to the fourth-grade students.

The low frequency derivatives fell into three categories, on the basis of their suffix: Eight had high frequency Non-neutral suffixes, eight had high frequency Neutral suffixes, and eight low-frequency Neutral suffixes. The forms used are listed in Table 2.

[Insert Table 2 about here.]

Design and Analysis

A mixed factorial design was used, with item type (suffixed or nonsuffixed target word) and suffix type (high-frequency neutral, low-frequency neutral, and non-neutral) as within-subject factors, and grade (4, 6, & 8) and test version as between-subject factors. The order of items within the test was randomized, but the same order was used in both versions.

Results and Discussion

Table 3 presents subject means. For each grade and category of derivative, three values are given. The first is the proportion of correct answers for suffixed items, corrected for guessing. The second is the proportion of correct answers for the items with the base words, also corrected for guessing. The third number is the ratio of the first to the second--an informal indication of what proportion of suffixed items subjects would have gotten correct of those items for which they could answer the non-suffixed version correctly. Means in this table are collapsed across test version.

[Insert Table 3 about here.]

Results of a MANOVA show a main effect of grade ($F(2,94) = 39.6, p < .001$), a main effect of item type (suffixed versus nonsuffixed items; $F(1,94) = 19.0, p < .000$), and a main effect of suffix type ($F(2,94) = 120.2, p < .000$). The main effect of test version was not significant ($F(1,94) = 1.9, p = .173$). There was a significant version x suffix type interaction ($F(2,94) = 4.5, p = .012$), and also a grade x item type x suffix type interaction ($F(4,94 = 4.0, p = .004$).

The main effect of item type shows that suffixed items were more difficult than nonsuffixed items. The fact that at all grade levels, students scored higher on non-suffixed items than on suffixed items shows that novel derived forms continue to cause readers some difficulty through eighth grade.

The main effect of grade indicates that older subjects were better at answering both types of items. The non-significance of the grade x item type interaction ($F(2,94) = 0.2, p = .793$) shows that additional difficulty offered by suffixed items did not change across grades. This result suggests that

children do not substantially increase in their lexical semantic knowledge of suffixes between grades four and eight. The ability to see lexical semantic relationships between stems and their derivatives is presumably the most basic level of morphological knowledge. It appears that fourth graders have already attained a substantial grasp of this basic level of morphological knowledge.

The interaction of item type with suffix type was not significant ($F(2,94 = .09, p = .910$. This indicates that at the grade levels tested, children evidenced no difference between Neutral and Non-neutral derivatives in terms of lexical semantic knowledge.

The grade x suffixation x suffix type interaction does not allow a straightforward interpretation. Comparison of the proportions in Table 3 shows that in fourth grade, Non-neutral suffixes were most difficult, followed in order by low frequency Neutral suffixes and then high frequency Neutral suffixes. This order is what would be predicted, but tests of simple effects indicate that this difference (represented by a suffixation x suffix type interaction) is not significant within the fourth grade ($F(2,94 = 2.0, p = .138$). However, this order is significantly, although inexplicably, reversed in sixth grade ($F(2,94 = 4.4, p = .013$.

Our results also illustrate some of the methodological problems involved in assessing children's knowledge of morphology. The main effect of suffix type indicates that attempts to make all items equally easy were not successful; inspection of the means shows that items for Non-neutral suffixes were consistenely harder than items for Neutral suffixes, whether the suffixed word or its familiar stem was being tested. The version x suffix type interaction similarly shows that division of items within each suffix type into two groups for constructing the two versions of the test did not result in groups of equal overall difficulty.

Non-suffixed items were included as a baseline, and were not intended to pose difficulty for even the youngest subjects. We were surprised to find that even at eighth grade, subjects scored well below 100% on these items. Subjects' relatively low scores on non-suffixed items reflect general limitations on reading and test-taking ability. Therefore, failure to answer the suffixed items correctly cannot be attributed solely to lack of morphological knowledge.

Results of Experiment 1 indicate that fourth graders have already attained basic knowledge of both Neutral and Non-neutral derivatives in terms of their ability to recognize that a novel suffixed word is related to its stem. There is an overall increase in performance across grades, but this appears to be due to factors such as increased reading ability, vocabulary, and test taking skills, rather than any specific increase in the ability to see lexical semantic relationships between known words and unfamiliar derivatives.

Experiment 2

Knowledge of Syntactic Properties of Suffixes

The second aspect of suffixal knowledge under consideration is knowledge of the syntactic properties of suffixes. A primary function of derivational suffixes is to change the part of speech of the stem. Even if one does not know the stem of a word, the derivational suffix can often give unambiguous information about its syntactic category. For instance, one should be able to gather from their endings that *aggression* is a noun and *aggressive* is an adjective without knowing the "stem" *aggress*.

In order to measure students' knowledge of the syntactic properties of suffixes with a minimum of extraneous task demands, a multiple choice format was chosen in which the student was asked to choose which of four words fit best into a blank in a sentence. The four words differed only in their suffix, so that a correct choice would reflect knowledge of the syntactic contribution of the suffix. The fact that the four choices differ only by suffixes should also focus the students' attention on the

suffixes, and hence maximize the likelihood that they would apply to this task whatever knowledge of suffixes they possess.

A potential weakness in this design, however, is that children could conceivably learn the part of speech of derived words without attributing any particular syntactic properties to the suffix. For example, one could learn that *aggression* is a noun without analyzing the word into stem and suffix, in the same way that one learns that *joy* is a noun, even though it has no overt marking of its part of speech. Therefore, a more stringent test of knowledge of the syntactic properties of suffixes would be a multiple choice item such as just described, but with the four choices consisting of nonce stem plus a variety of suffixes. Answering such an item correctly, aside from chance, is unmistakable evidence that the student knows the syntactic properties of the suffix.

Method

Subjects

Subjects were the same 40 fourth-grade, 30 sixth-grade, and 30 eighth-grade students who took part in Experiment 1. The test described here was the third part of a three-part paper-and-pencil task.

Materials

Real word items. Sixteen items, such as the example in Table 4, were constructed. Each item consists of a sentence with a blank. Beneath the sentence are four words which differ only in their suffixes. The task is to circle the word that fits best into the sentence.

[Insert Table 4 about here.]

In half of the items, the correct answers had Neutral suffixes; in the other half, they had Non-neutral suffixes. Most of the suffixed words appeared in the *Ginn Word Book* (1983), and hence were likely to be familiar to many fourth graders, and most sixth and eighth graders.

Nonce word items. Sixteen additional items parallel to those exemplified in Table 4 were constructed, but using nonce words with suffixes in place of real words. An example of this type of item is given in Table 5.

[Insert Table 5 about here.]

Two versions of each item were created, one in which the nonce words had Neutral suffixes, and one in which the nonce words had Non-neutral suffixes. Each subject saw each item only once, half in the Neutral suffix version and half in the Non-neutral suffix version. Neutral and Non-neutral items were randomly ordered.

In the complete test, the 16 real word items came first, followed by the 16 nonce word items.

Design and Analysis

A mixed factorial design was used, with item type (real word items or nonce word items) and suffix type (Neutral or Non-netural) as within-subject factors, and grade (4, 6, and 8) and test version as between-subject factors.

Results and Discussion

Table 6 gives the means, corrected for guessing. Figures are collapsed over test version. Results of a MANOVA show a main effect for grade ($F(2,94) = 38.3$, $p < .001$), and a main effect of item type ($F(1,94) = 222.5$, $p < .001$). No other main effect or interaction was significant. Post-hoc tests revealed that all cell means were significantly greater than zero, except for fourth graders' scores for Neutral nonce word items.

[Insert Table 6 about here.]

Experiment 2 was replicated with a second group of students consisting of 21 fourth graders, 50 sixth graders, and 38 eighth graders. Results, given in Table 7, were almost identical to those of the first group of students, with the exception that fourth grade means for both Neutral and Non-neutral nonce words were higher, and both were significantly greater than zero.

[Insert Table 7 about here.]

Our results show that students at all grade levels tested have at least some knowledge of the syntactic properties of suffixes. In the main experiment, students at fourth grade did not perform significantly above chance for Neutral nonce word items; in the replication, fourth graders performed above chance on both types of nonce word items. Fourth grade, therefore, appears to be the point at which students are becoming able to apply their knowledge of syntactic properties of suffixes to derivatives formed from unfamiliar stems.

Fourth graders are already performing significantly above chance on the real word items. This clearly shows that they are able to distinguish among derived words that differ only in their suffixes. The performance on real word items in itself does not demonstrate knowledge of the syntactic properties of the suffixes, since the students could be treating these words as unanalyzed units. However, the fact that fourth graders are beginning to successfully answer nonce word items demonstrates that they have begun to recognize the syntactic properties of suffixes. This knowledge can only have come from analyzing known derivatives.

The main effect of grade, and the lack of significant interactions with grade, indicates that older subjects did better on all types of items to a roughly equal extent. We believe that the substantial increase in scores, especially between fourth and sixth grades, represents some growth in knowledge of the syntactic contribution of suffixes. However, at least some of this increase might also be due to gains in vocabulary and test-taking skills.

The main effect of item type shows that subjects did better with real word items than with nonce word items. The presence of an unfamiliar or unknown stem appears to constitute an extraneous source of difficulty, which hinders at least some students from demonstrating what knowledge of suffixes they do possess. This sheds some light on the differences in performance between the subjects in Condry's (1979) and Freyd and Baron's (1982) studies. In the former study, children as young as third grade evidenced knowledge of morphological relationships between familiar words (e.g., *argue* and *argument*); in the latter, eighth graders failed to utilize morphological relationships when learning nonce stems and their derivatives. The lack of any effect of suffix type shows that students at all three grade levels knew the syntactic properties of Neutral and Non-neutral suffixes equally well.

Experiment 3

A third aspect of knowledge about suffixes tested in this study is distributional knowledge. All suffixes are constrained by the syntactic category of the base they attach to, e.g., *-ness* attaches to adjectives (*happy/happiness*), *-ize* attaches to nouns (*critic/criticize*). Many suffixes also have

restrictions such as [+Latinate]; for example, *-ity* attaches to Latinate adjectives (as in *rude/rudity*) but not Germanic adjectives (*bad/*badity*).

This aspect of knowledge about suffixes should be the last to be acquired; children would have to recognize a suffix as such, and have at least some idea of its syntactic contribution, before they could figure out in exactly which ways its distribution is restricted. Furthermore, we expect that in the process of acquiring distributional knowledge about suffixes, learners will go through a period of incomplete distributional knowledge marked by overgeneralizations, i.e., the use or acceptance of words (such as **badity* or **repeatize*) in which the presence of a suffix violates constraints on the distribution of that suffix.

Overgeneralizations occur when the child has recognized the existence of a linguistic regularity, but has not yet precisely identified its range of application (Bowerman, 1982). This could happen because the child has not learned specific exceptions to otherwise productive rules, e.g., that the plural of *mouse* is *mice* and not **mouses*. Or the child might misanalyze words, producing doubly marked forms such as **feets* and **sheeps*, or failing to add a plural morpheme to words such as *house* and *rose* which already end in alveolar fricatives. As with inflections, the person learning derivational morphology must learn lexical exceptions to otherwise productive rules (e.g., that the agentive form of *to spy* is *spy* and not **spyer*), and restrictions on the distribution of suffixes.

Overgeneralizations provide the clearest type of evidence that acquisition of morphological processes as a productive rule is taking place. MacWhinney (1978) has argued that overgeneralization is the major indicator of a productive, rule-governed process, and that the failure to overgeneralize is indicative of memorization or analogical processes. Therefore, it is crucial to include some way of looking for overgeneralizations in any attempt to arrive at a systematic picture of the acquisition of derivational morphology.

Assessing Overgeneralization with Nontimed Lexical Decision Tasks

Overgeneralizations of inflectional suffixes, such as **feets* or **eated*, are very frequent in the speech of young children. Researchers of child language acquisition have compiled long lists of inflectional overgeneralizations in young children's speech (Berko-Gleason, 1971). Evidence for derivational overgeneralization, on the other hand, although it does occur, is harder to come by. Speakers are generally less likely to make up new words using derivational suffixes than to apply inflectional suffixes to new forms. However, it is possible to tap overgeneralization by measuring subjects' willingness to accept novel forms that violate distributional constraints.

Anderson and Freebody (1983), using a type of nontimed lexical decision task (similar to the task used by Aronoff & Schvaneveldt (1978) to determine adult subjects' knowledge of the distributional constraints of derivational suffixes), found that high-ability fifth graders were more likely than low-ability fifth graders to say they knew the meanings of novel derived forms such as **kindment*. Saying that one knows the meaning of a novel derived form such as **kindment*, which violates distributional constraints of the suffix *-ment*, can be taken as a type of overgeneralization, hence as evidence that subjects are in the process of learning about derivational suffixation as a productive, rule-governed process. Nagy, Anderson, and Herman (1987) used a similar task with third, fifth, and seventh graders, and found that the tendency to accept novel derived forms appeared to peak between 5th and 7th grade, after which the tendency declined, again suggesting a period of overgeneralization. However, Nagy, Anderson, and Herman did not differentiate between well-formed novel derivatives such as *dogless* and ill-formed derivatives such as **earthless*. The purpose of Experiment 3 was to determine if this finding could be replicated, and to extend it in two ways. First, a distinction was made between well-formed and ill-formed novel derivatives, and second, a systematic distinction was made between Neutral suffixes and Non-neutral suffixes.

We hypothesized that at a certain stage in their acquisition of derivational morphology, children would accept an increased number of ill-formed derivatives as words of English, indicating that they were formulating general morphological rules that did not yet incorporate all the necessary constraints on distribution of suffixes. Later this tendency to accept ill-formed derivatives would decline, indicating that they had acquired more adultlike formulations of the rules. Because of the increased complexity of Non-neutral suffixation, we hypothesized that the overgeneralization peak for Non-neutral suffixes would occur at a later age than the peak for Neutral suffixes, indicating that children acquire Non-neutral suffixes after Neutral suffixes.

Method

Subjects

Subjects included the same 40 fourth-grade, 30 sixth-grade, and 30 eighth-grade students who took part in Experiments 1 and 2. Because pilot studies had indicated that important changes in performance on this task might occur after eighth grade on this type of task, data from 29 undergraduate students at a large midwestern university tested in a separate session were also included in the analyses.

Materials

A 171-item nontimed lexical decision test was developed. Each item consisted of a word or nonce word followed by the words *Yes* and *No*. Subjects were instructed to circle *Yes* if they knew the meaning of the word and *No* if they did not. The list was comprised of items of several categories:

1. Real word of English words that ranged from low-frequency (e.g., *emir*) to high-frequency (e.g., *ocean*). Subjects' scores on these words provided a general measure of vocabulary knowledge.

2. Phonologically possible but non-occurring words (e.g., *werpet*).

3. Experimental words which were suffixed words, 20 of which were well-formed (i.e., obey distributional constraints) and 20 of which were ill-formed (i.e., violate distributional constraints). Half of both the well-formed and the ill-formed derivatives were suffixed with Neutral suffixes and half with Non-neutral suffixes. The stems from which derivatives were formed were balanced for length and frequency. A list of these forms appears in Table 8.

[Insert Table 8 about here.]

All the derivatives were intended to be words that subjects were unlikely to have seen before. Well-formed derivatives were intended to be possible, although infrequent, words in English. In fact, all of the well-formed derivatives except for *interiorist* and *centrate* appear in *Webster's Third Unabridged Dictionary*. Those that did appear in Carroll, Davies, and Richman's (1971) *Word Frequency Book* were low in frequency--all occurred less than three times in 10 million words of text, and all but three occurred less than once in 10 million words of text. Thus, it is very likely that our subjects had seen or heard very few, if any, of the derivatives in this lexical decision task.

Three versions of the test were constructed, each with a different randomized order of items.

Procedure

Experiment 3 was administered as the first part of a three-part test of morphological ability. Tasks were ordered in this way so that subjects' performance on Experiment 3 would not be influenced by any knowledge that the experiments had to do with derivational suffixes--a fact that may have been apparent from the materials for Experiment 1, and was obvious in Experiment 2.

Design and Analysis

Of primary interest was subjects' performance on the four categories of derivatives. A mixed factorial design was used, with well-formedness and suffix type (Neutral or Non-neutral) as within-subject factors, and grade (fourth, sixth, eighth, and college) as a between-subjects factor.

The dependent measure was the proportion of derivatives responded to as known, corrected for yes-proneness according to the formula $(P - NW)/ (1 - NW)$, where P is the subjects' (uncorrected) proportion of derivatives in a category, and NW is the proportion of nonwords responded to as known.

Results and Discussion

Results of a MANOVA show a main effect of grade ($F(3,125) = 10.6$, $p < .001$), a main effect of well-formedness ($F(1,125) = 377.9$, $p < .001$), and a main effect of suffix type ($F(1,125) = 113.2$, $p < .001$). Among the two-way interactions, grade x well-formedness was significant ($F(3, 125) = 28.3$, $p < .001$), as was well-formedness x suffix type ($F(1,125) = 5.3$, $p = .023$). The grade x suffix type interaction was not significant ($F < 1.0$). The three-way interaction of grade x well-formedness x suffix type was also significant ($F(3,125) = 2.7$, $p = .046$).

Since the subjects had probably not seen any of these particular suffixed forms before, the fact that subjects say they know their meanings on the lexical decision task is itself an indication that they have some knowledge of derivational morphology. The main effect of well-formedness indicates that subjects are able to distinguish well-formed from ill-formed derivatives. Tests of simple effects show that this main effect is highly significant even for fourth graders ($F(1,125) = 23.8$, $p < .001$). The significant grade x well-formedness interaction indicates, however, that the difference in responses to well-formed and ill-formed derivatives increases with grade level. To some extent, this interaction may be due to the fact that, as the main effect of grade indicates, older subjects respond to more forms. This increase may reflect in part increasing knowledge of the stems, but since stems were chosen to be high-frequency, familiar words, the main effect of grade is very likely to also represent an increasing ability to recognize novel derived forms.

The main effect of suffix type indicates that derivatives with Neutral suffixes were accepted as words significantly more often than suffixes with Non-neutral derivatives. Thus, the non-timed lexical decision task, unlike the two preceding experiments, gives a clear reflection of the difference in productivity between the two classes of suffixes.

The interpretation of the well-formedness x suffix type and grade x well-formedness x suffix type interactions becomes apparent from a graphic representation of the means for the four categories of derivatives at each grade tested, as given in Figure 1.

[Insert Figure 1 about here.]

The well-formedness x suffix type interaction reflects the fact that the difference between Neutral and Non-neutral suffixes is greater for ill-formed than for well-formed derivatives. Tests of simple effects indicate that this interaction is significant only in sixth and eighth grade; hence the grade x well-formedness x suffix type interaction.

The basis of these interactions lies in the inverted-U curve for ill-formed neutral derivatives. This curve replicates the peak acceptance of novel derivatives found at about seventh grade by Nagy, Herman, and Anderson (1985). This is the prototypical overgeneralization pattern found in many aspects of language learning, and is exactly the type of curve one would expect to find for productive lexical processes.

The curve for Non-neutral, ill-formed derivatives shows a sharp contrast. This flat curve indicates that subjects do not go through a period of overgeneralization during the acquisition of Non-neutral derivatives.

Replication

The inverted U curve found for ill-formed Neutral derivatives was a confirmation of expectations based on earlier studies (Anderson & Freebody, 1983; Nagy, Anderson, & Herman, 1987). However, since such curves have sometimes been found difficult to replicate, materials identical to those used in Experiment 3 were administered to a second group of students, 21 fourth graders, 50 sixth graders, and 38 eighth graders. Results of this replication are compared with the results of Experiment 3 in Table 9. It can be seen from the table that results are essentially identical.

[Insert Table 9 about here.]

The results of Experiment 3 and its replication show that fourth graders already have substantial, although incomplete, distributional knowledge of derivational suffixes. In addition to the fact that subjects say they know the meaning of more Neutral derivatives than Non-neutral derivatives, they appear to pass through a period of overgeneralization during the acquisition of Neutral suffixes, but do not pass through a similar period of overgeneralization for Non-neutral suffixes. What makes this finding all the more intriguing is that although subjects accept almost no ill-formed Non-neutral derivatives as words, they do accept well-formed Non-neutral derivatives, at almost the same rate as they do well-formed Neutral derivatives. Subjects appear to be acquiring knowledge of the distributional constraints for Non-neutral derivatives as well as for Neutral derivatives; but only in the case of Neutral derivatives do they pass through a temporary phase of increased errors. How can this paradoxical performance be accounted for?

Differential knowledge of the stems is not likely to be a factor, since tems of the four categories of derivatives were matched for length and frequency. Nor is it plausible that there is a period of overgeneralization for Non-neutral suffixes earlier than, or later than, the ages represented by our subjects. It therefore appears that children's acquisition of the two types of suffixes is categorically different. The overgeneralization curve indicates that children learn the rules that govern Neutral derivatives as general, productive processes, similar to the rules of inflectional morphology. The flat curve associated with the Non-neutral derivatives, on the other hand, suggests that the rules governing these suffixes are not learned as general, productive processes. We believe that the difference in how the two rule types are acquired is largely linked to the differences in applicability of the two types of suffixes.

Neutral suffixes tend to have a wide range of applicability. This makes it possible for the learner to focus primarily on the suffix without paying close attention to the specific properties of the words it attaches to. It may also allow the learner to initially form very simple concatenation rules, e.g., for the suffix *-er* they may formulate a rule along the lines of "put *-er* on any noun or verb to form an agentive." The application of this form of the rule would result in overgeneralization, i.e., either in the production or acceptance of ill-formed derivatives. It is easy to find anecdotal evidence of children using nonce forms that appear to come from such rules. For instance, Chris, age eight, said, "I want to watch the *darters*" meaning "people who play darts."

Non-neutral suffixes, on the other hand, have much more limited applicability. The idiosyncracy of stem+affix concatenation requires the learner to attend to both the suffix and the particular root it attaches to. In other words, to correctly specify the distribution of Non-neutral suffixes, one must refer to specific properties of the stem, including its phonological form; for Neutral suffixes, one needs to know only the general syntactic category of the stem.

MacWhinney (1978) has presented evidence from the acquisition of inflectional morphology in seven languages showing that rote, analogy and combination are all important processes in acquiring morphology. Under the process of rote, words are memorized and are not analyzed or assigned internal structure. Within generative linguistics, Venneman (1974) has most strongly argued for rote as the primary method of acquisition of morphophonology. In a child, behavior associated with rote learning would be the ability to correctly produce both regular and irregular forms such as *shoes* and *oxen*, along with the inability to add inflection to nonsense forms.

Analogy is typically defined as free extension to new items from existing items perceived to share the relevant property. The pertinent question in discussions of word formation is just what constitutes the relevant property. MacWhinney argues that the relevant property has to do with phonological shape of the words being compared. Thus, if **pang* were to be used as the past tense of the verb *to ping*, this would constitute the use of analogy.

Finally, when the child produces incorrect real words (*feets, ated*) and only regularized nonsense forms, there is evidence of productive combination. MacWhinney sees combination as the formulation of a very general rule that has a wide range of application.

Our results give evidence of productive combination for only Neutral derivatives. The acceptance of the ill-formed derivatives can be accounted for in terms of a general rule with an overly wide range of application. For example, in the case of a novel derivative formed from a Neutral suffix, such as **repeatize*, the minimal strategy (the one adopted during the overgeneralization phase) may be to strip off a known suffix and simply check whether the remainder is a known word or not. Older subjects seem to add the further test of checking if the stem is the right part-of-speech.

The puzzling finding is that our subjects appear to be learning something about the distributional properties of Non-neutral suffixes, as evidenced by the acceptance curve of well-formed Non-neutral derivatives, without showing the additional effect of overgeneralization shown with inflectional and Neutral suffixes. The subjects are somehow able to make more selective, accurate assessments of ill-formed Non-neutral derivatives than their Neutral counterparts. We hypothesize that when the subjects encountered a well-formed Non-neutral derivative, such as *educative*, they did not simply strip off the suffix *-ive* and see if the remainder was a known word. (If they followed this strategy, they should have accepted a word like *wheelic*, which in fact had a low acceptance rate). Rather, we hypothesize that they searched their memories for phonological forms that could serve as the basis of analogy. In the case of *educative*, for example, the subject would not simply strip off the suffix *-ive* to determine whether the remainder was a known word or stem. Rather, the subject would search his or her memory for words ending in *-ative*, and see if such words took part in any consistent patterns of relationships with other words. In this case, there are many word pairs in English (approximately 450 in Lehnert's (1971) *Reverse Dictionary of English*) such as *cooperative/cooperate* that would serve as the basis for an analogical link from *educative* to *educate*. However, in the case of an ill-formed Non-neutral derivative such as *initialive*, there are no likely candidates for analogy ending in *-alive* (other than the word *alive*) and none in *-live*, other than *live* and *olive*. The inclusion of part of the stem in the search for a basis for analogy would thus account for subjects accepting unfamiliar well-formed Non-neutral derivatives without accepting ill-formed ones.

In sum, a plausible explanation for the different behavior of Neutral and Non-neutral derivatives in Experiment 3 is that children formulate general rules by which they analyze and accept novel derivatives formed from Neutral suffixes but they use analogical processes that refer to the

phonological form of the root when they analyze and accept derivatives formed from Non-neutral suffixes. The use of analogical processes that refer to the form of the root for Non-neutral derivatives can, in turn, be accounted for by the fact that Non-neutral suffixes are, in fact, more closely tied to their stems. Their distribution is more dependent upon the identity of the stem, and the orthographic form and pronunciation of the stem are more often and more radically affected by the Non-neutral suffix.

Intercorrelations of Measures from Experiments 1, 2, and 3

Table 10 gives the intercorrelations of measures from the three experiments. Correlations between measures from Experiments 1 and 2 are higher than those between either Experiment 1 or 2 and Experiment 3. This is probably due to the fact that Experiments 1 and 2, but not Experiment 3, used a multiple-choice format. Thus, much of the correlation between the measures in Experiments 1 and 2 can be attributed to reading ability and test-taking skills, rather than to any specific morphological knowledge. The high correlation between the derivative and stem items in Experiment 1 corroborates this.

[Insert Table 10 about here.]

The correlations between the measures in Experiment 3 and the other two experiments are surprisingly low; recognizing a novel well-formed derivative in the non-timed lexical decision task in Experiment 3 would seem to require some of the same knowledge and skills that were tested in the other two experiments. These low correlations suggest that how well an individual demonstrates his or her knowledge of morphology is highly dependent on the specific task, and that different aspects of morphological knowledge are relatively distinct.

General Discussion

Results from this study confirm our expectation that different aspects of knowledge about suffixes are acquired at different times. Although our results do not allow us to specify a particular age at which each aspect of knowledge is acquired, they are consistent with the hypothesis that children first acquire basic lexical-semantic knowledge of derived forms, that knowledge of syntactic properties of suffixes may develop more slowly, and that knowledge of distributional constraints on suffixes reflects the most sophisticated level of knowledge, and is the last to be acquired.

Subjects' performance in Experiment 1 indicates that they have already attained a basic level of lexical semantic knowledge by fourth grade; the fourth graders performed at better than chance level in recognizing the relationship between novel derivatives and known words. The overall improvement in performance over grades appears to be due to an increase in vocabulary and test-taking skills, rather than any gains in this aspect of morphological knowledge.

Knowledge of the syntactic properties of suffixes seems to develop slightly later than basic lexical-semantic knowledge; in Experiment 2, many fourth graders did not demonstrate knowledge of the syntactic properties of Neutral suffixes in items with nonce words. However, one cannot directly compare subjects' performance in Experiments 1 and 2 to determine the relative order of the acquisition of lexical semantic and syntactic knowledge of derivational morphology, since the task in Experiment 2 may have been intrinsically more difficult.

Type of suffix--Neutral vs. Non-neutral--did not have a significant effect on performance in either Experiment 1 or Experiment 2, but had a strong effect in Experiment 3. In the case of Experiment 1, the lack of an effect of suffix type might be attributed to the low level of knowledge required. To answer a multiple-choice question based on the lexical semantics of a novel derivative, one simply must recognize its relationship to a known word--e.g., to see the *educate* in *educative*. All one need

know about the suffix in this case is that it is a suffix, knowledge that may be equally well-developed for both Neutral and Non-neutral suffixes.

The lack of a significant effect of suffix type in Experiment 2 may follow from the nature of the differences between Neutral and Non-neutral suffixes. Although Neutral and Non-neutral suffixes differ in several regards, they do not differ in the regularity of their syntactic contribution to the derivative. Most words ending in *-ness* are nouns, but there are a few exceptions (e.g., *to witness*). Similarly, most words ending in *-ion* are nouns, but there are also exceptions (*to requisition, to position*). If different aspects of knowledge about suffixes are acquired independently, one would therefore expect that Neutral and Non-neutral suffixes would not differ substantially in terms of syntactic knowledge.

Consistent and significant differences between Neutral and Non-neutral suffixes were found, however, in Experiment 3, in which knowledge about distribution of suffixes was measured. This is not at all surprising, since it is in terms of freedom of distribution that Neutral and Non-neutral suffixes most consistently differ.

The prediction that Neutral suffixes are acquired before Non-neutral suffixes is therefore confirmed, but only with respect to distributional knowledge. One could speculate that in terms of lexical semantic and syntactic knowledge, Neutral suffixes may be acquired before Non-neutral suffixes, but that any differences have already disappeared by fourth grade; however, our results give no indication of this.

Our results thus give strong support to the hypothesis that knowledge of suffixes is compartmentalized. Basic lexical semantic knowledge of suffixes appears to be acquired by fourth grade for both Neutral and Non-neutral suffixes. Fourth graders also have significant knowledge about the distribution of suffixes of both types of suffixes; but major gains in the amount and nature of distributional knowledge occur even after eighth grade, and these gains clearly differentiate the learning of Neutral and Non-neutral suffixes.

A comparison of the results of Experiments 1, 2, and 3 shows that the nature of the experimental task has a large effect on how and whether subjects display their knowledge of derivational suffixes. Experiment 1 especially shows that it is easy enough to construct a task in which some knowledge of derivational morphology is a necessary condition; but it is quite another matter to devise a task which could guarantee that any knowledge of derivational morphology would be reflected in the subjects' performance. It is in Experiment 3, in which extraneous task demands are minimized, that we have the clearest picture of the development of morphological knowledge, and of the differences between Neutral and Non-neutral suffixes.

Finally, the replication of an overgeneralization curve in the acquisition of Neutral suffixes and the lack of such a curve for Non-neutral suffixes offer some support for a model of the lexicon that categorically differentiates the two classes of suffixes and the rules that govern them. The results of these experiments show that there are clear differences in how Neutral and Non-Neutral suffixes are acquired. We have suggested that children formulate very general rules of combination for Neutral suffixes, which are used both to analyze and produce new forms, whereas they use narrow rules of phonological analogy to analyze unfamiliar Non-neutral forms. In terms of a theoretical model of the lexicon, this difference could be represented by a model (such as that proposed in Tyler, 1986) in which Non-neutral derivatives are related to their respective bases by non-productive redundancy rules, while Neutral derivatives are related by productive word formation rules. Whatever model we finally accept, however, must be able to explain the fact that children pass through a period of overgeneralization for Neutral, but not for Non-neutral, suffixes.

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Table 1

Example Multiple Choice Item from Experiment 1

a) Version with Derivative

"I'm in a *celebratory* mood," Mary announced.

Mary felt like:

a) having a party
b) being alone
c) going to sleep
d) having a fight
e) don't know

b) Version with Stem

"I'm in a mood to *celebrate*," Mary announced

Mary felt like:

a) having a party
b) being alone
c) going to sleep
d) having a fight
e) don't know

Table 2

Derivatives Used in Experiment 1

Non-Neutral Suffixes	Neutral Low-Frequency Suffixes	Neutral High-Frequency Suffixes
educative	pupilship	silverize
explosivity	costwise	pailful
valuation	darksome	searchist
centrate	babyhood	finishers
celebratory	marblelike	knowfully
astronautic	queendom	chairless
contrarian	mountaineer	sickish
odorous	spoilage	mildness

Table 3

Results of Experiment 1

		Proportion of Correct Answers*		
Grade	Suffix Category	Derivative Items	Stem Items	Ratio of Correct Derivative Items To Correct Stem Items
4	Non-Neutral	.21 (.27)	.32 (.39)	.66
	Neutral Low-Frequency	.40 (.45)	.56 (.37)	.71
	Neutral High-Frequency	.44 (.37)	.45 (.36)	.98
6	Non-Neutral	.59 (.25)	.63 (.30)	.94
	Neutral Low-Frequency	.78 (.29)	.85 (.21)	.92
	Neutral High-Frequency	.58 (.36)	.85 (.22)	.68
8	Non-Neutral	.68 (.28)	.79 (.27)	.86
	Neutral Low-Frequency	.89 (.21)	.93 (.19)	.95
	Neutral High-Frequency	.82 (.27)	.94 (.14)	.88

*Means corrected for guessing, standard deviations in parentheses

Table 4

Example Real-Word Item, Experiment 2

You can _____ the effect by turning off the lights.

intensify intensification intensity intensive

Table 5

Example Nonce-Word Item, Experiment 2

I wish Dr. Who would just _____ and get it over with.
transumpation transumpative transumpate transumpatic

Table 6

Results of Experiment 2

	Proportion of Items Answered Correctly*			
	Real-Word Items		Nonce-Word Items	
Grade	Neutral	Non-Neutral	Neutral	Non-Neutral
4	.49 (.27)	.41 (.39)	.07 (.26)	.14 (.22)
6	.76 (.25)	.82 (.20)	.34 (.33)	.32 (.36)
8	.96 (.10)	.96 (.10)	.52 (.37)	.58 (.30)

*Means corrected for guessing; standard deviations in parentheses

Table 7

Results of Experiment 2 Replication

	Proportion of Items Answered Correctly*			
	Real-Word Items		Nonce-Word Items	
Grade	Neutral	Non-Neutral	Neutral	Non-Neutral
4	.48 (.33)	.32 (.28)	.25 (.26)	.20 (.22)
6	.67 (.33)	.57 (.34)	.40 (.31)	.35 (.34)
8	.86 (.17)	.85 (.21)	.62 (.30)	.58 (.30)

*Means corrected for guessing, standard deviations in parentheses

Table 8

Low-Frequency Derivatives of High-Frequency Stems Used in Experiment 3

Neutral		Non-Neutral	
Well-formed	Ill-formed	Well-formed	Ill-formed
generalship	particularable	valuation	forestify
flattish	repeatize	positional	wheelic
pourable	atmospherely	claimant	wheneveral
dreamful	destroyism	educative	butterence
plasticize	seldomist	explositivy	crustion
chewer	snapness	astronautic	uglitude
defeatism	loyalment	centrate	thievant
tameness	harshful	odorous	alertity
centerless	purposehood	contrarian	initialive

Table 9

Results of Experiment 3 and Replication

	Proportion of Derivatives Reported as Known*			
	Neutral		Non-Neutral	
Grade	Well-formed	Ill-formed	Well-formed	Ill-formed
	Experiment 3			
4	.31 (.20)	.16 (.16)	.16 (.22)	.06 (.14)
6	.49 (.20)	.30 (.20)	.37 (.24)	.07 (.13)
8	.50 (.18)	.26 (.23)	.42 (.20)	.04 (.11)
College	.64 (.25)	.19 (.27)	.56 (.21)	.05 (.12)
	Replication			
4	.35 (.20)	.13 (.16)	.17 (.19)	.01 (.10)
6	.46 (.21)	.32 (.21)	.36 (.26)	.08 (.14)
8	.44 (.24)	.23 (.17)	.42 (.23)	.06 (.10)

*Means corrected for guessing; standard deviations in parentheses

Table 10

Intercorrelations of Measures from Experiments 1, 2, and 3*

	1	2	3	4	5	6	7	8	9	10	11	12
1	-	.64	.65	.72	.70	.55	.72	.51	.17	.18	.30	-.17
2		-	.60	.77	.69	.56	.74	.45	.39	.23	.38	-.14
3			-	.63	.58	.55	.61	.44	.24	.28	.35	-.17
4				-	.62	.53	.68	.48	.31	.18	.29	-.25
5					-	.56	.76	.54	.27	.29	.45	-.11
6						-	.57	.66	.19	.17	.28	-.16
7							-	.50	.25	.23	.43	-.21
8								-	.31	.24	.39	.03
9									-	.55	.60	.19
10										-	.50	.20
11											-	.19

*Critical value $r = .23$, $p = .01$

Table 10 (Continued)

Variables
Lexical-semantic knowledge (Exp. 1)
1. Neutral derivatives*
2. Neutral stems*
3. Non-neutral derivatives
4. Non-neutral stems
Syntactic knowledge (Exp. 2)
5. Neutral real words
6. Neutral nonce words
7. Non-neutral real words
8. Non-neutral nonce words
Distributional knowledge (Exp. 3)
9. Neutral well-formed derivatives
10. Neutral ill-formed derivatives
11. Non-neutral well-formed derivatives
12. Non-neutral ill-formed derivatives

*Note: Subject means for high-frequency and low-frequency Neutral suffixes were combined in computing these correlations.

Figure Caption

Figure 1. Proportion of derivatives reported as known in Experiment 3.

PROPORTION OF DERIVATIVES REPORTED
AS KNOWN IN EXPERIMENT 3